Achieving flexible and sustainable energy systems

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Flex4RES
Flexible Nordic Energy Systems

Achieving flexible and sustainable energy systems

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Energy Economics and Regulation
DTU Management Engineering , Denmark

Nordic Energy Research
Nordic Council of Ministers

DTU Management Engineering

Systems Analysis division

Poul Erik Morthorst

Kenneth Karlsson

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Simon Bolwig

Ninette Pilgaard

- Energy Systems Analysis (ESY)
  - Global and regional energy system optimisation models (all sectors)
  - Integration of intermittent renewables in energy systems
  - GIS prepossessing tools
  - Quantitative scenario analysis
- Energy Economics and Regulation (EER)
  - Analyses of regulatory frameworks and market designs that facilitate the transition towards larger share of renewable energy in the energy system, energy savings, and climate change
  - Policy analysis and economic assessment
  - Economic and social aspects of wind integration, coupling of markets, and flexibility options
  - Demand behaviour based on technical/economic or econometric models
- Climate Change and Sustainable Development
  - Modelling of climate Change mitigation, renewable energy, and smart cities;
  - Decision making tools for climate change impacts and adaptation
- Transport Economics

Sister departments

DTU Wind Energy
Department of Wind Energy

DTU Energy
Department of Energy Conversion and Storage

DTU Elektro
Institut for Elektroteknologi

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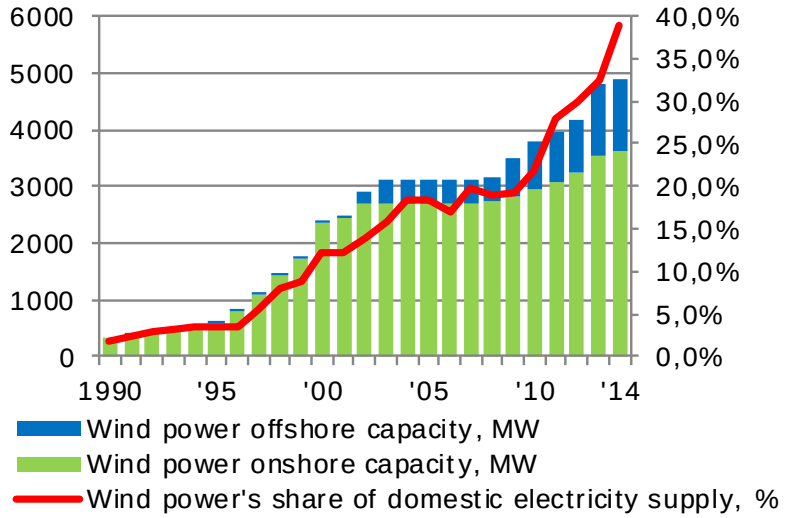
Denmark - The Country of Wind and District Heating

Wind 42% share (2015).



Political targets:

- **2020:** 50% of traditional electricity consumption covered by wind power
- ***2035:*** *All electricity and heat based on renewable energy*
  (Obs. the previous governmental position)
- **2050:** The total* energy supply based on renewable energy
  *Total energy system incl. heat, gas, transport, industry, etc.

District heating:

- 50% share of total heat supply, with 69% CHP and <1% P2H

The Future Energy System

RE-thinking of Energy Policy towards Sustainable Energy Systems

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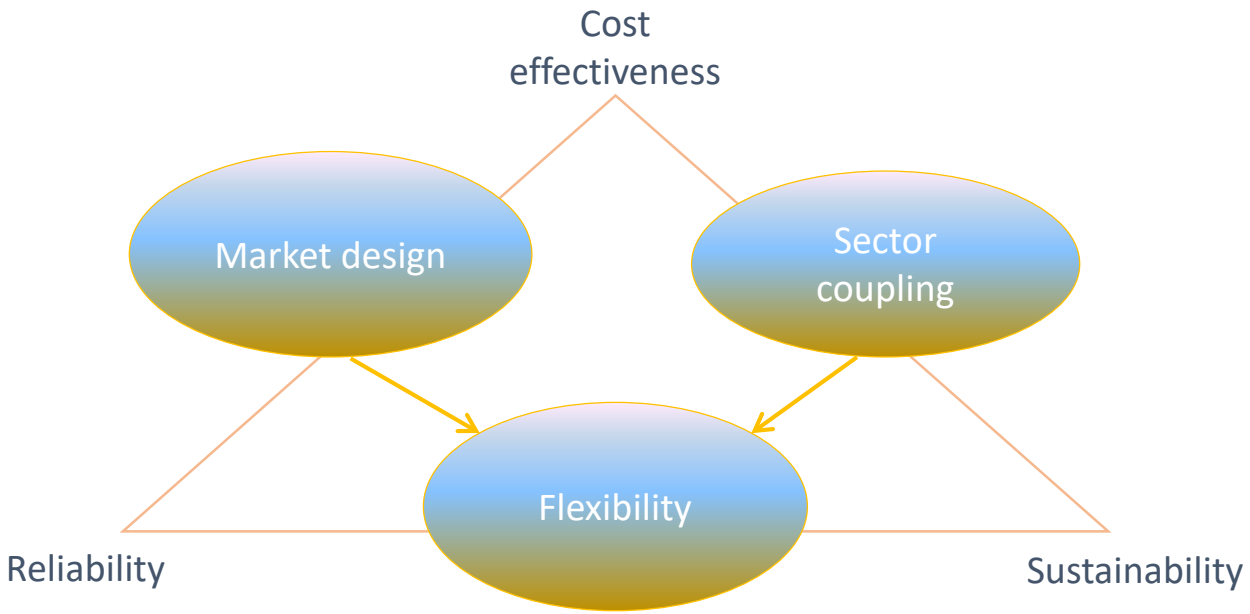
Current electricity system → The trichotomy of energy policy → Decarbonised energy systems

Centralised fossil-intensive supply

Electricity market only

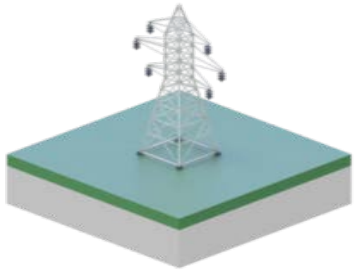


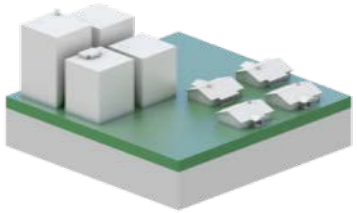
Decentralised
+
Variable renewable energy
+
Phase-out of fossil peakers

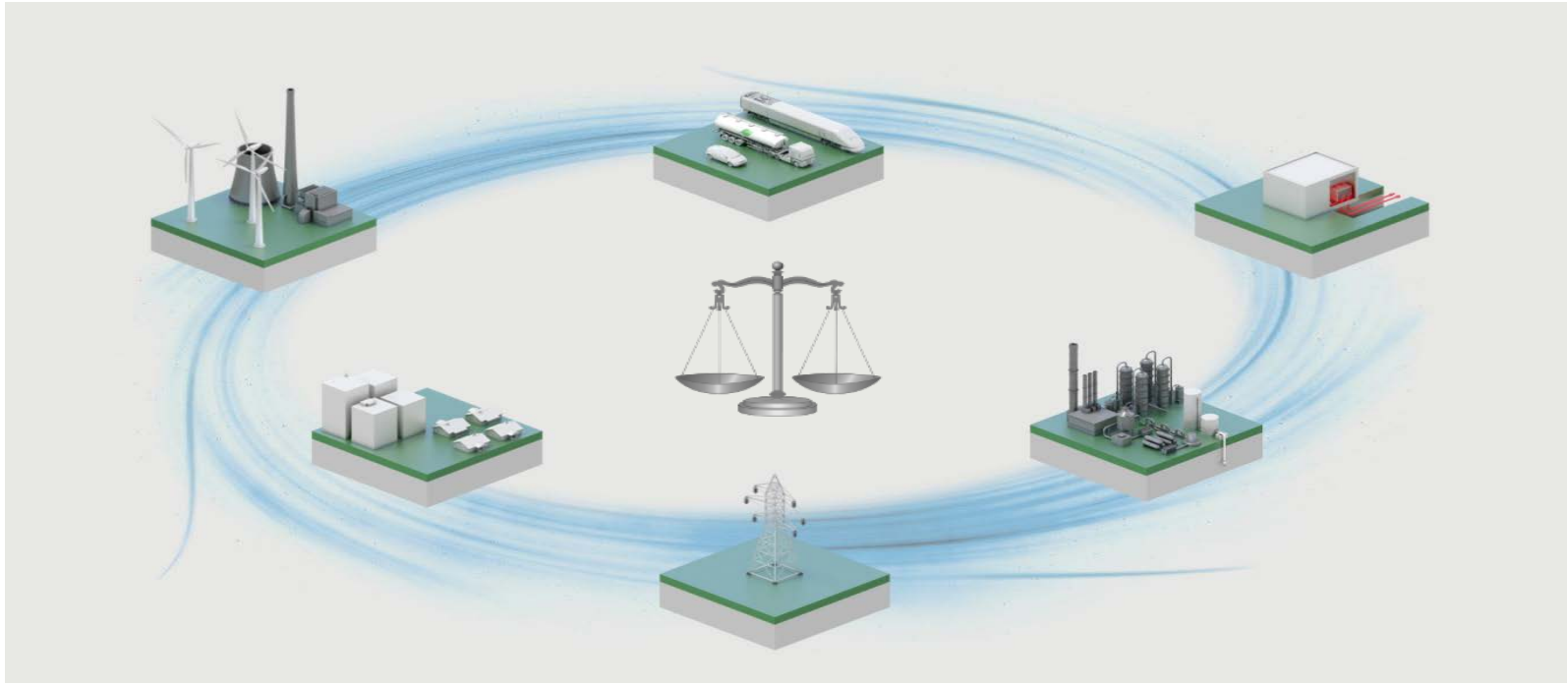
System integration

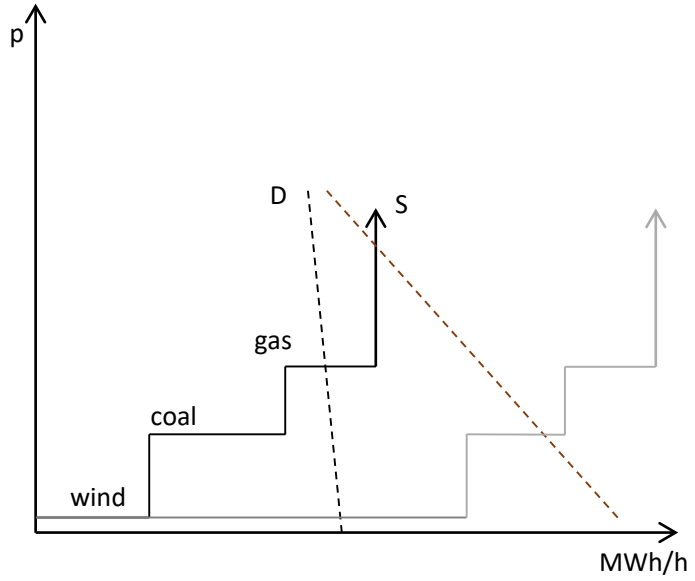
Flexibility Resources/Market Actors

Electrification/sector coupling - Finding ramping capabilities



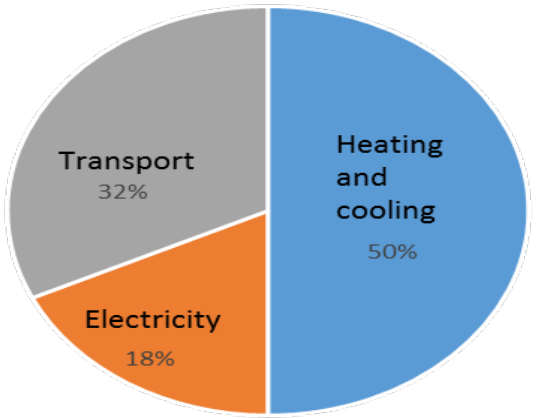




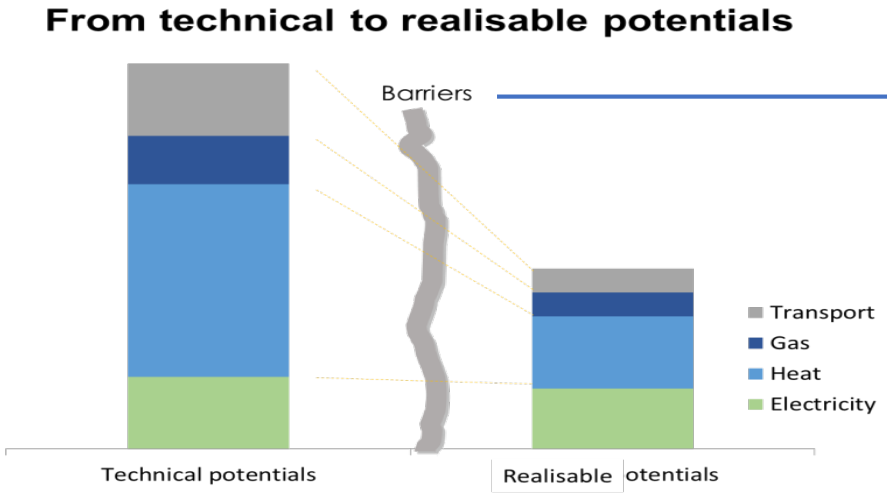


Sector coupling

Electrification as source of flexibility



Distribution of EU energy consumption
(Source: EU Heating and Cooling strategy)

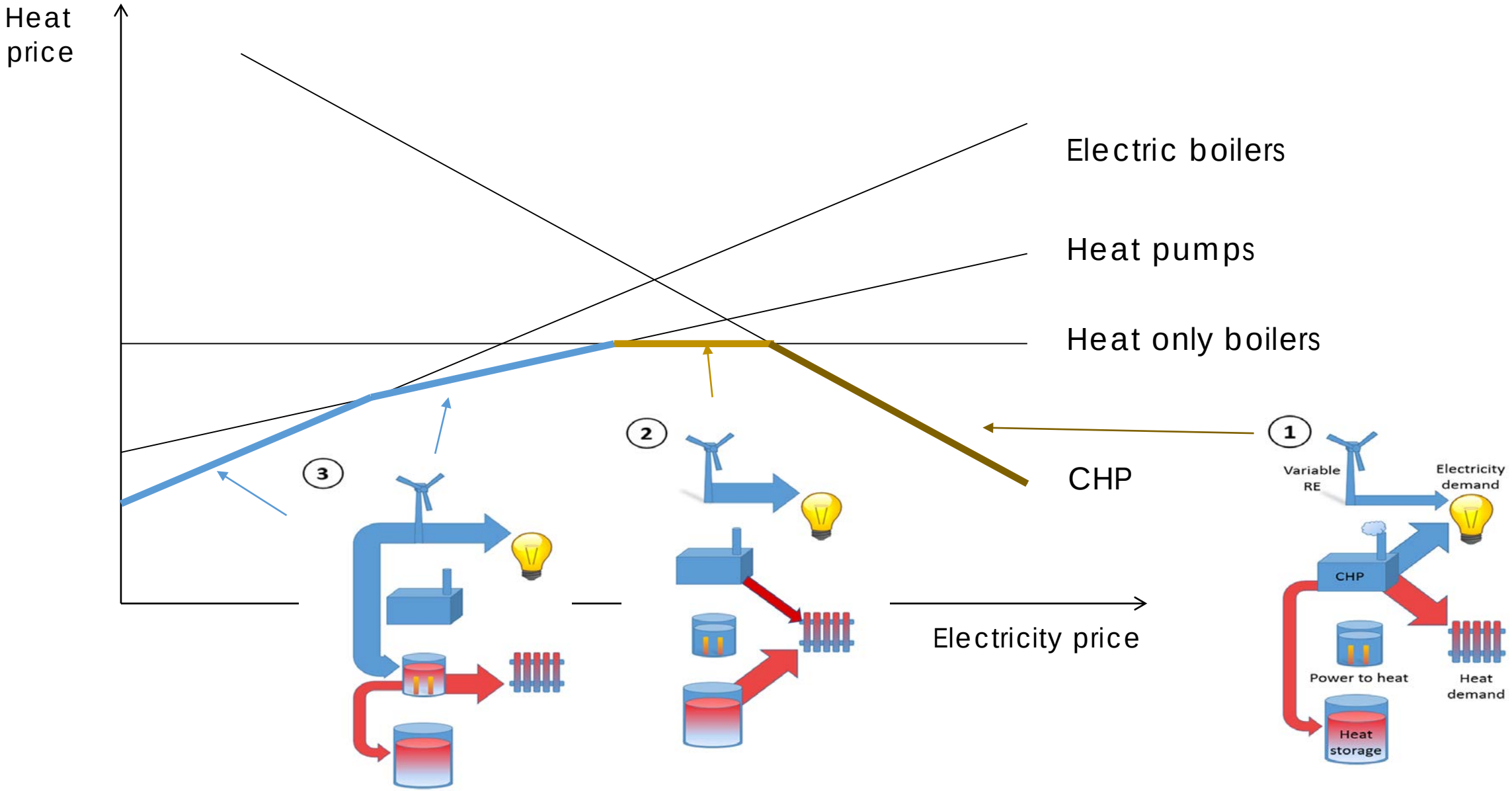


Framework conditions

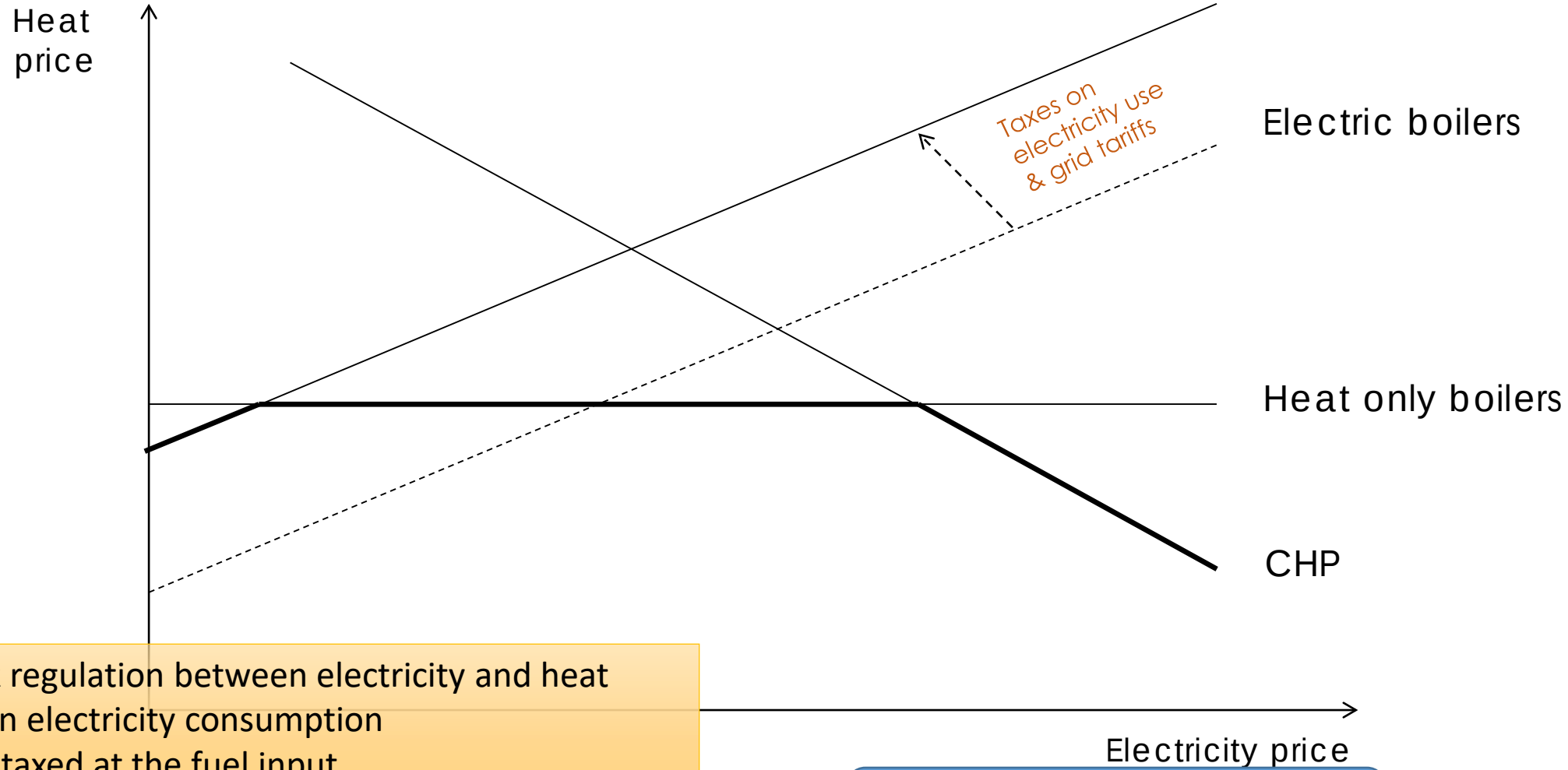
- Market design
- Direct regulation
- Fiscal policies
- Support schemes
- Grid regulation

Large flexibility potentials in electrification of the energy sectors → Hindered by regulatory barriers → Remove barriers

District heating-electricity interface



Choice of heat supply - at different electricity prices



Patchwork regulation between electricity and heat

- Taxes on electricity consumption
- Heat is taxed at the fuel input
- Biomass exempted for taxes

More heat only boilers.
Decoupling of electricity and heat markets

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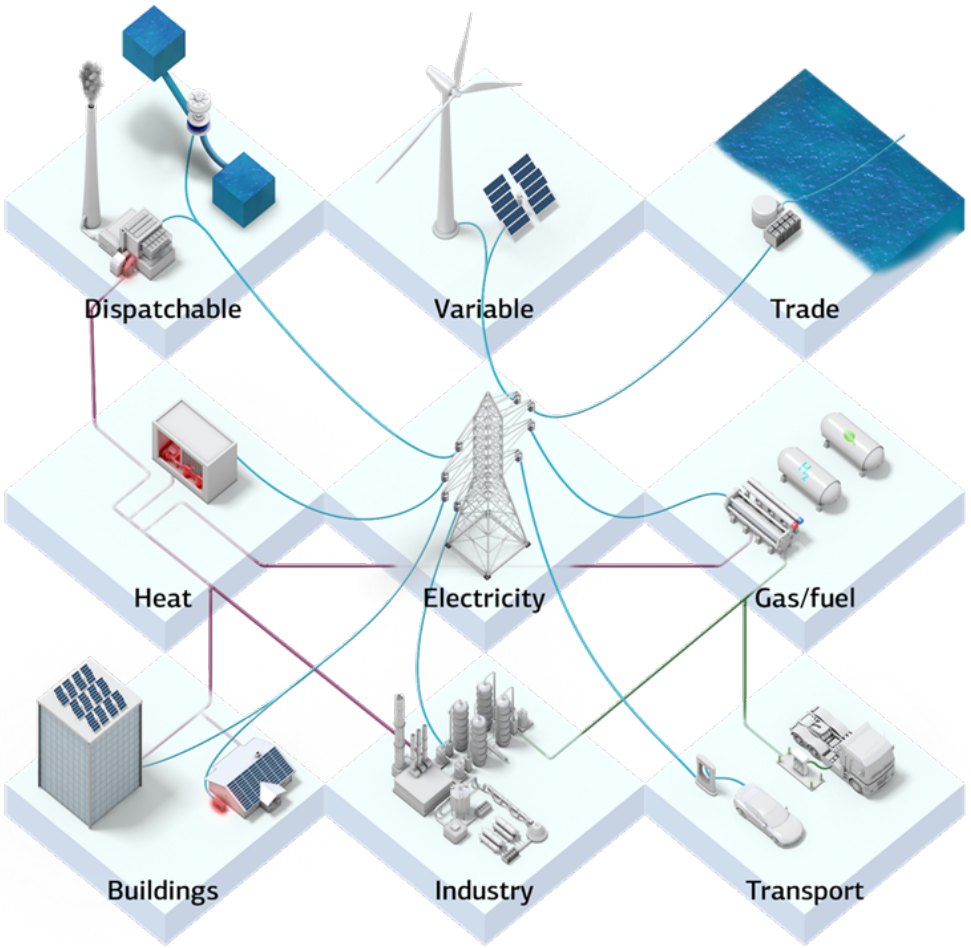
Flexibility for Variable Renewable Energy Integration in the Nordic Energy System

Integrating a high share of variable renewable energy through enhanced energy market interaction

Identify and assess regulatory and technical pathways towards coherent Nordic energy systems in 2050 based on strong interaction between different energy markets that ensure resilience, sustainability and efficiency.

Nordic Energy Research
Flagship project
September 2015 - March 2019



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Thank you for your interest

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